The history of one *Epeïra Aurelia* is the history of the whole species.

It works with the most consummate skill; but when it has made its marvellous snare for the capture of prey, it trusts to accident alone, and uses no artifice to entice that prey. So also with regard to its cocoon. Nothing could be more perfectly adapted to the purpose for which it is intended; but directly this beautiful structure is finished, the spider is utterly indifferent to, and apparently ignorant of, its existence, which is proved by my having always taken away the cocoons the morning after they were made, without producing the slightest effect upon the *Epeïra*.

Thus they are governed in everything they do by an all-wise and immutable law, which compels them, so to speak, to make the best provision for themselves and for the protection of their eggs—for the permanence and reproduction, in short, of their race; and this, it would seem, is the end and aim of their existence.

Thurlow, Clapham, S., May 1865.

LII.—*Notes on the* Hydroida. By Prof. Allman, F.R.S.

I. *Syncoryne pulchella*, mihi, n. sp.

In April last I obtained at Skelmorlie, on the Firth of Clyde, a pretty little Corynidan Hydroid, which might have been seen spreading in small patches over the bottom of the rock-pools near low-water mark. It turns out to be a species of *Syncoryne**, distinct from any hitherto described, and may be defined by the following diagnosis.

Trophosome.—Hydrocaulus consisting of simple stems rising at intervals from a creeping reticulated stolon, and attaining a height of about half an inch; periderm destitute of annulation, and only with a few shallow transverse corrugations towards the base. Polypite with fifteen to twenty tentacles. Body of polypite deep orange, becoming pale where it passes into the stem; stem orange.

Gonosome.—Gonophores borne on short peduncles in a dense cluster immediately behind the most posterior tentacles. Um-

* The name of *Syncoryne*, adopted from Ehrenberg in a restricted sense, is intended to embrace those species of the older genus *Coryne* which have phanerocodonic gonophores, referable, at the period of their liberation, to the type of *Oceania* as limited by Forbes and, still more definitely, by Gegenbaur. (See a paper on the genera of the Hydroida in the 'Annals of Nat. Hist.' for May 1864.)

brella of Medusa set with scattered thread-cells, and with its transverse and vertical diameters nearly equal. Two longitudinal furrows exist upon the concave surface of the umbrella; they are situated exactly opposite to one another, each occupying the middle line of the interval between two neighbouring radiating canals, and extending from the base of the manubrium to the margin of the bell. Marginal tentacles of Medusa very extensile, nodulated with clusters of thread-cells, which give them a moniliform character when extended, one larger spherical cluster terminating the tentacle. Tentacular bulbs with a distinct ocellus. Manubrium and tentacular bulbs deep orange.

Rooted to the bottom of rock-pools, near low-water mark, Skelmorlie, Firth of Clyde.

Syncoryne pulchella, though of humble habit, is yet conspicuous by the bright orange-colour of its polypites and medusa-buds. It is evidently nearly allied to the *Syncoryne decipiens* * of Dujardin, with which indeed I was at first disposed to regard it as identical. It agrees with it closely in the form of the Medusa, and in the fact that all the gonophores are borne behind the most posterior tentacula. Like the Medusa of the present species, that of *S. decipiens* is described as being provided with linear longitudinal furrows on the concave surface of the umbrella. In *S. decipiens*, however, each of the four intervals which separate the radiating canals is stated to be occupied by one of these furrows, while in the present species only two of them are so occupied. The trophosome also of *S. pulchella* differs from that of Dujardin's species in its simple habit, in the more ovate form of the polypite, and in its more numerous tentacles.

With *Syncoryne eximia* the present species closely agrees in the form of the Medusa, though the trophosomes of the two species are very different from one another. The Medusæ, indeed, are scarcely distinguishable, except in the fact that the subumbrellar furrows do not exist in those of *S. eximia*.

The longitudinal furrows which we meet with on the concave surface of the umbrella are probably formed by a peculiar modification of the substance of the umbrella forming two fixed lines of attachment for the circular contractile fibres.

While examining the Medusæ which had been thrown off

* In a synopsis of the genera and species of the *Tubularinæ*, published in the 'Annals of Natural History' for May 1864, I regarded *Syncoryne decipiens*, Dujard., as a synonym of *S. Sarsii*, Lovén. Though in this view I followed so excellent a zoophytologist as Mr. Alder (Catal. Zooph. of Northumberland and Durham, Supplement, p. 3), I am now convinced that the two species are distinct.

from a group of *Syncoryne pulchella* in one of my jars, I was struck by observing two of these Medusæ united to one another by a small space on the convex surface of their umbrellas, at a short distance from the summit. One of the united Medusæ was a little smaller than the other; but otherwise they were both equally developed, and presented the ordinary condition of these zooids at the time of their liberation from the trophosome. The cavities of the two umbrellæ freely communicated with one another through the surface of junction.

That neither of the Medusæ thus so intimately united had been produced by a bud from the other was evident; for the original point of union with the trophosome and the canal by which the cavity of the manubrium had at one time communicated with the somatic cavity of the trophosome were still distinct in each; while these facts are also opposed to the view which would regard the twin Medusæ as representing a single one in the process of self-division.

The only explanation which it seems possible to suggest is that in the twin Medusæ we have a case of accidental adhesion contracted between two neighbouring buds while still connected with the trophosome, though it is difficult to see why this adhesion should have been followed by a free communication between the two umbrella-cavities. I never met with more than a single example; and, whatever explanation we may be disposed to offer as to its origin, it seems evident that it cannot be regarded as otherwise than an abnormal occurrence.

Though many of the Medusæ which, nearly a month ago, had become liberated from the trophosome are still living in my jars, no formation of generative elements has taken place in any of them. They have, however, all undergone a very remarkable change.

The commencement of this change might have been observed a few days after their liberation. The umbrella became everted, and then began to diminish in size, contracting from its margin towards its summit, until in a few days it had almost entirely disappeared, being then merely represented by a thick disk of a somewhat quadrangular form, which projected round the base of the manubrium. Each of the four angles of this disk was continued into one of the marginal tentacles, whose base, following the contraction of the umbrella, had been thus brought upon a level with the base of the manubrium. The interior of the disk was occupied by a cavity which communicated freely with that of the manubrium and with that of each of the four tentacles which extended from its angles. With the contraction of the umbrella the circular canal and velum had disappeared, and the radiating canals were now represented solely by the short

channels by which the interior of the hollow disk communicated, through the thickness of its walls, with the tubes of the tentacles. Neither tentacles nor manubrium had undergone any material change; the former retained their full power of extension and retraction, and the latter all its original irritability—moving from side to side, lengthening and shortening itself, opening and closing its mouth, with at least as much vigour as before the disappearance of the umbrella. The Medusa in this condition reminded us strongly of the gonophore of *Clavatella*, though the degradation of the umbrella was more complete than in the latter. The Medusa had in fact become changed by a retrograde metamorphosis into a polypite.

Changes had been noticed also by Dujardin in the Medusa of his *Syncoryne decipiens*; but he had not followed them beyond an eversion of the umbrella, which is probably the commencement of the changes resulting in the disappearance of this part of the structure.

Notwithstanding the very striking character of the changes now described, and their resemblance to a normal metamorphosis, I cannot see in them anything more than a degradation of structure resulting from imperfect nutrition—a mere forerunner of complete disintegration and death. They are, however, most instructive in their bearing upon the homologies between the Medusa and the polypite, and completely support the view that the radiating canals of the Medusæ are the homologues of the channels by which the gastric cavity of the polypite is continued through the thickness of its walls into the interior of the tentacles, which will then represent those marginal tentacles of the Medusa which constitute the continuations of its radiating canals.

II. *The Production of an Æginidan by gemmation from* Geryonia.

A discovery of great importance in its bearing on the true relations of the *Æginidæ* has been just announced by Ernst Haeckel*, who has seen a Medusa belonging to the family of the *Geryonidæ* (*Geryonia hastata*, Haeck.) giving origin, within the cavity of its manubrium, to buds which, instead of repeating the form of the *Geryonia*, become developed into a species of *Cunina* (*Cunina rhododactyla*, Haeck.), a Medusa belonging to the aberrant and hitherto perplexing group of the *Æginidæ*.

Further, according to the author's views, the bud-producing

* "Ueber eine neue Form des Generationswechsels bei den Medusen, und über die Verwandtschaft der Geryoniden und Æginiden." Auszug aus dem Monatsbericht der Königl. Akad. der Wissensch. zu Berlin, 2 Feb. 1865. [Translated in the present Number of this Journal.]

Geryonia is in a state of sexual maturity, and the buds which are produced by it become developed into sexual *Cuninæ*. And, still further, from having observed in the sea various free-swimming forms which he regards as different stages in the development of the *Geryonia*, he considers it probable that this Medusa is produced by a process of direct development from the ovum, his observations in this respect coinciding with those of Fritz Müller on the nearly allied *Liriope catharinensis**.

Of the phenomena thus observed he gives the following generalized statement:—A perfectly developed Medusa which has been produced by metamorphosis from a larva, and is capable of sexual multiplication, gives origin, by a process of budding in its stomach-cavity, to young Medusæ, which develope themselves into perfect sexual forms entirely different from that of the Medusa from which they spring. And in these facts the author believes that there is presented an entirely new type of alternation of generations—a type totally different in its fundamental principles from the phenomena which have been hitherto included under this name, and one for which a new term is needed.

While the observations of Haeckel, however, can scarcely be too highly estimated for the light they throw upon the relations between the *Geryonidæ* and *Æginidæ*, it appears to me that he greatly overrates the difference between the genetic phenomena which are here presented and those already well known among the Hydroida.

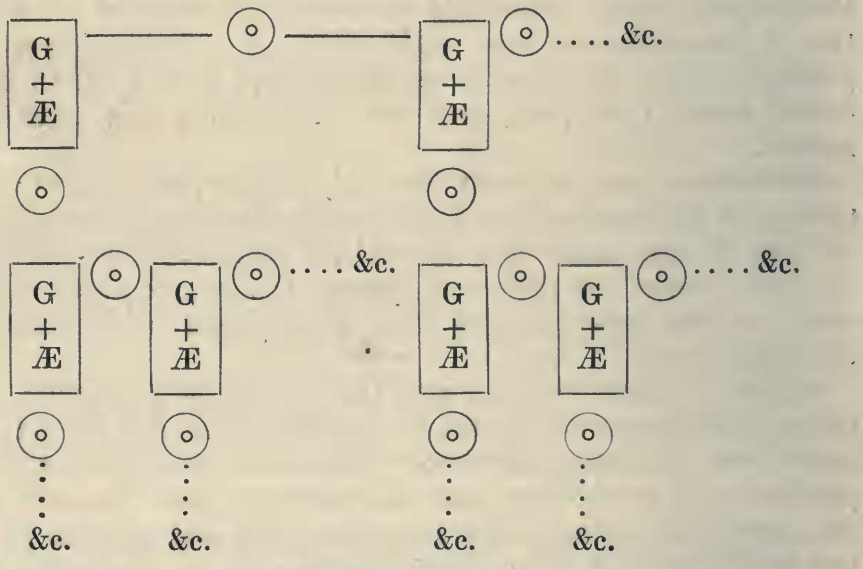
It must be kept in mind that the essence of alternation of generations consists (1) in the interposition, between every two acts of true generation, of one or more acts of non-sexual multiplication; (2) in the fact that the heteromorphic elements in an alternation are invariably connected with one another by a non-sexual and not by a sexual genesis; (3) in the fact that these elements exactly repeat themselves after each generative act.

Now in the present case, admitting that Haeckel has given a correct interpretation of the phenomena, we have the development of an ovum resulting by direct metamorphosis in a Geryonidan Medusa which produces by non-sexual reproduction an Æginidan Medusa, this last being sexually perfect, so that it gives origin to fertile ova. So far the phenomena would come exactly within the ordinary laws of alternation of generations; but a disturbing element is introduced by the fact of the *Geryonia* not only giving origin to buds, but also producing fertile ova. This is certainly an anomaly. I know of no other instance

* Wiegmann's Archiv, 1859, p. 310.

among the Hydroida in which all the zooids in an alternation of generations, whether capable of non-sexual reproduction or not, are at the same time sexual. But still the fundamental principle of the law is adhered to; the heteromorphic zooids in each period are connected with one another solely by gemmation, while the sum of the forms interposed between every sexual act is always exactly the same.

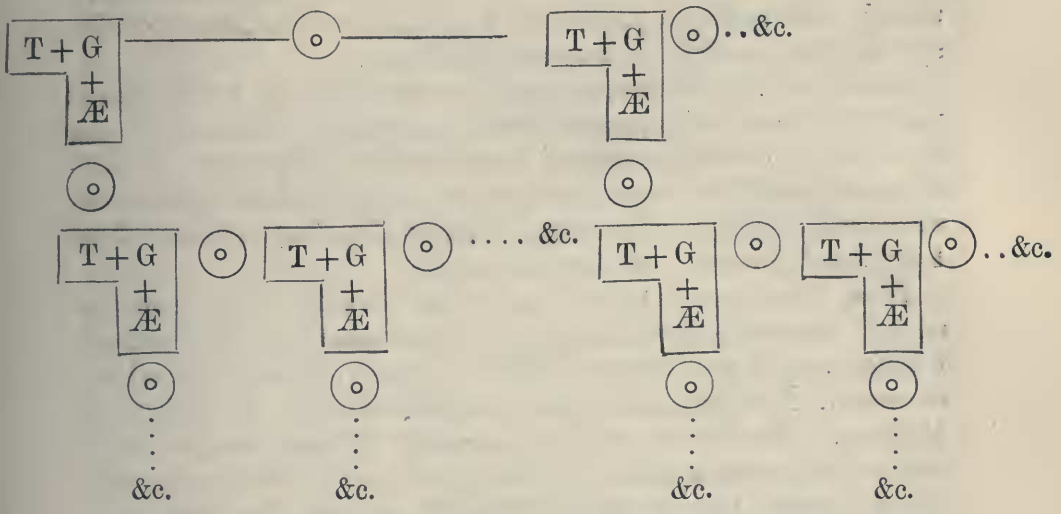
The phenomena in the present case may be expressed by the following diagram, in which the sign + is intended to indicate reproduction by gemmules, and ⊙ reproduction by ova; while G represents the Geryonidan and Æ the Æginidan element. The total result of the development of every ovum is included within a boundary-line; and it will be at once seen that it is in every case exactly similar.



It is here taken for granted that the development of the ovum in the Geryonidan element is the same as that in the Æginidan element; and until reasons can be shown to the contrary, we are justified in making this assumption.

I have also assumed that Haeckel is right in supposing that the *Geryonia* is developed directly from the ovum, without the intervention of a polypoid trophosome; but it will be at once seen that there is no evidence of this, and that, though a true metamorphosis may be proved, the earliest stage of the Medusa may yet be that of a bud upon a fixed though as yet undiscovered trophosome. If this be regarded as the true view, the elements which compose each period in the above diagram must be preceded by another, namely the polypoid element, which will then be the *immediate* product of the development of the

ovum. With this change, the diagram of the alternation would stand as follows, where T represents the trophosome :—



Now many instances are known in which Medusæ originating as buds from a polypoid trophosome give rise by gemmation to other Medusæ, both sets of Medusæ being also in all probability capable of sexual reproduction. *Sarsia, Hybocodon, Clavatella* may be cited as examples of this phenomenon; and the diagram expressing it would exactly resemble that just given, with this difference, that while the medusoid elements are, so far as we yet know, similar in *Sarsia*, &c., they are heteromorphic in the other. Fritz Müller* has recorded a case in which an 8-tentacled *Cunina* gave origin to buds which became developed into another form of *Cunina* having its parts disposed in accordance with the number 12, instead of 8. This would therefore be a case of true heteromorphic budding. The bud-producing Medusæ, however, had not in this instance been traced to a polypoid trophosome.

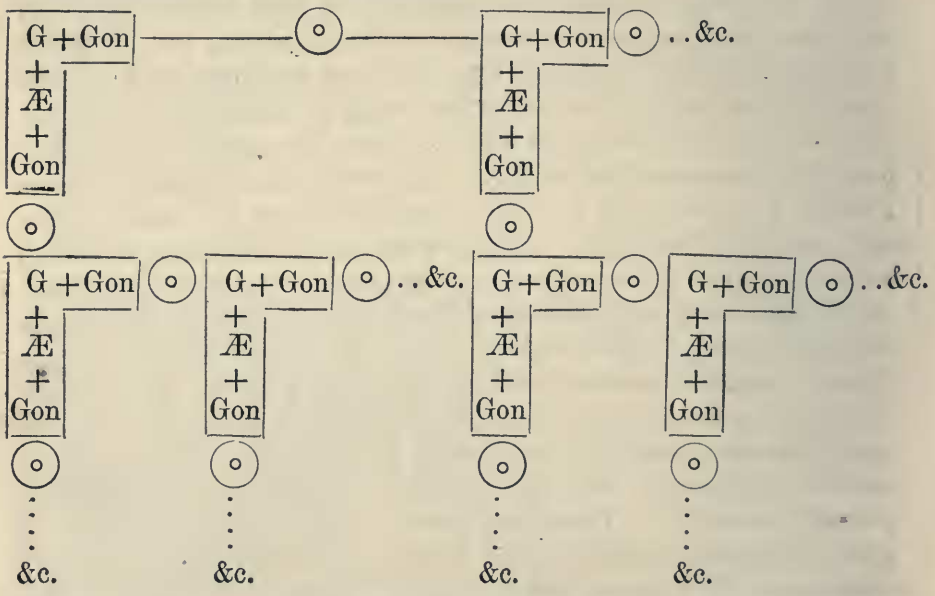
Though the phenomena as understood by Haeckel would thus present nothing really at variance with the fundamental principle of the law of alternation of generations, it must be admitted that they are very exceptional. We cannot lose sight of the anomalous fact that the medusoid elements in each period are not only dissimilar, but, according to Haeckel's view, are both properly sexual. A question, however, here suggests itself, Is it necessary to adopt Haeckel's interpretation of the phenomena? I believe not; on the contrary, I am strongly of opinion that the *Geryonia* is not a sexual Medusa at all, and I believe that the same may be asserted of the *Cunina*. Some years ago †, I insisted on the non-sexuality of those gymnophthalmic Medusæ which, like *Obelia, Eucope, Thaumantias*, &c., carry their genera-

* Wiegm. Arch. 1861. † Annals of Natural History, November 1859.

tive sacs upon the radiating canals; and I pointed out that the structure of these sacs was identical with that of the gonosacs of *Clava, Hydractinia,* &c., thus showing that they are definite zooids produced by a process of budding from the gastrovascular system of a properly non-sexual Medusa*.

This view I endeavoured further to develope in a subsequent paper†, when I designated such non-sexual Medusæ by the name of "gonoblastocheme," showing that they must be carefully distinguished from the proper sexual Medusa such as we meet with in *Sarsia, Oceania, Bougainvillia,* &c., and for which I proposed the name of "gonocheme."

Now, I believe that the flat leaflike pouches in *Geryonia* are entirely homologous with the more prominent generative sacs of *Obelia*; and if so, *Geryonia* must be viewed not as a gonocheme or sexual Medusa, but as a gonoblastocheme or non-sexual Medusa. The nature of the ova- and spermatozoa-producing bodies in *Cunina* is more doubtful; but still I can scarcely hesitate to regard the generative elements as here also produced in true gonosacs of essentially the same form as in *Geryonia*. The doctrine of the gonoblastocheme will thus at once give us the key to the explanation of the apparently anomalous phenomena discovered by Haeckel, and will enable us to express them in the following form, where Gon represents the gonosac.

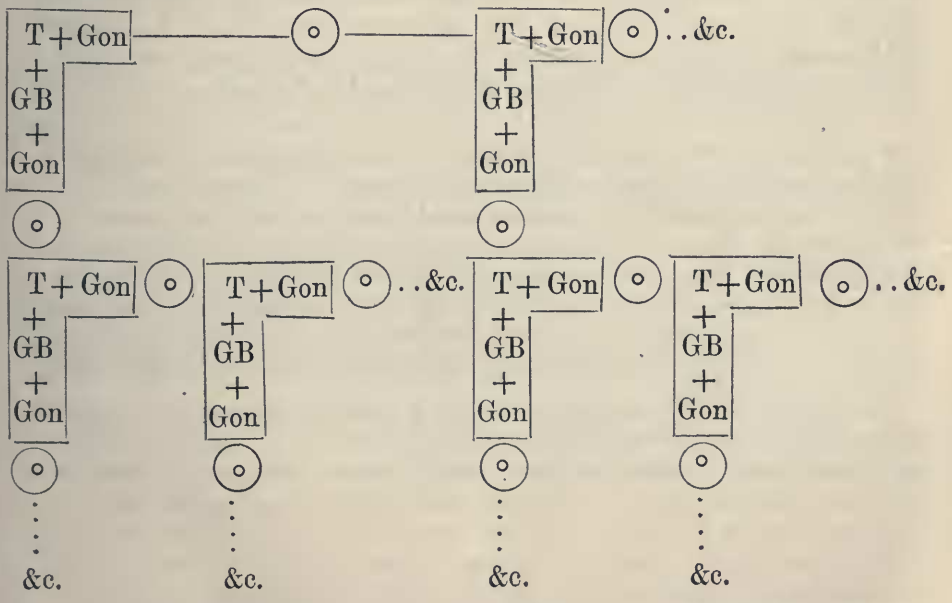


* Leuckart had already recognized the zooidal nature of the generative sacs in *Aglaura* (Wieg. Arch. 1856), and T. S. Wright had expressed an opinion that in every gymnophthalmic Medusa all parts which are borne by the umbrella—manubrium, tentacles, and generative sacs—must be regarded in the light of buds. (Proc. Roy. Phys. Soc. Edin. 1856–57.)

† Report on the Hydroida, Brit. Assoc. Rep. 1863.

I have here assumed, with Haeckel, the direct development of *Geryonia* from the egg; so that *Geryonia*, a non-sexual Medusa, takes the place of a non-sexual polypoid trophosome. But, as already said, there is no proof that *Geryonia* has not originated as a bud from a polypoid trophosome; and if so, G ought to be preceded by T in the above diagram—an addition which would merely increase the polymorphism without affecting the principle.

In no case, however, is the polymorphism of the zooids greater than what is well-known to occur among the Hydroida—as, for instance, in *Campanularia*, where the polypoid trophosome gives origin by budding to a gonoblastidium, and this to a gonoblastocheme, which in its turn developes, by a similar non-sexual act, the sexual bud or gonosac. The form of the diagram of *Geryonia*, however, differs from that of *Campanularia*, inasmuch as *Campanularia* presents a simple linear series, while in *Geryonia*, in consequence of one and the same zooid (the Geryonidan) producing *two* sets of heteromorphic buds (the gonosac and the Æginidan), we have a series presenting two branches, which run off in different directions. This, however, is exactly what occurs in *Hydractinia echinata*, in which the gonosac is borne not only on a gonoblastidium, but also occasionally on the trophosome directly*. This will be at once obvious if the diagram just given be compared with the following, which represents the alternation in *Hydractinia*, and in which the symbol GB is used to indicate the gonoblastidium. It will then be apparent that the two have precisely the same form.



* As pointed out by Dr. T. Strethill Wright (Proc. Roy. Phys. Soc. of Edinb. Nov. 1856).

While Haeckel has thus done good service to our knowledge of the *Hydroida* in pointing out a genetic relation between the *Æginidæ* and the *Geryonidæ*, his labours have been at least as valuable in showing that the structure of the *Æginidæ* is in all essential points identical with that of the *Geryonidæ*. He has proved, for example, that the circular marginal canal, hitherto denied to the *Æginidæ*, is really present; and there can accordingly no longer be any difficulty in placing these Medusæ in the same group with the rest of the Hydroid or gymnophthalmic forms*.

It cannot, however, be overlooked that the position of the Æginidan buds is remarkable and anomalous; for they are borne by the solid tongue-like process which in *Geryonia* projects from the base of the manubrium into its cavity. In almost every other known instance the somatic cavity of the Medusa-bud is in communication with some part of the somatic cavity of the Hydroid which produces it, while here such a communication is impossible before the development of the mouth in the bud shall enable the young Æginidan to receive nutriment from the stomach-cavity of the *Geryonia*. Three cases, however, all among the Æginidan Medusæ†, had been already described, in which the young Medusæ are formed as buds from the internal surface of the stomach-walls, and therefore, just as in the present instance, these young buds could not have had their somatic cavities in communication with that of the animal which carries them. The buds must accordingly have been formed in a very different way from that which takes place in the ordinary cases of budding Medusæ,—so different, indeed, that, were it not for the competency of the observers who have described them as cases of true budding, we should be disposed to regard them as suggesting parasitism rather than gemmation.

* The names of *Cryptocarpa*, Eschsch., *Gymnophthalmata*, Forbes, and *Craspedota*, Gegenb., are each, as is now known, inapplicable to certain members of the group of organisms which they were originally intended to distinguish. The inconvenience, however, arising from this fact may be avoided by the use of the designation *Hydroid Medusa*, which would include under it not only those gymnophthalmic forms which are known to proceed from polypoid trophosomes, but also such as have not been as yet so traced. "Medusa," however, must be understood as a *term* rather than as a systematic name.

† Gegenbaur, in 'Generationswechsel,' p. 56, *Cunina prolifera*; Keferstein and Ehlers, in 'Zoologische Beiträge,' 1861, *Ægineta gemmifera*; and Fritz Müller, in 'Wiegm. Arch.' 1861, *Cunina Köllikeri*.